Physics and Engineering
PLO 2: Application

Program Learning Outcome: Students will apply physical principles, mathematical reasoning, and computational techniques to solve real-world problems.

Measure: Embedded final exam question given in upper division mastery class on a rotating basis.

Criteria for success: At least 75% of students will achieve an average score of 2.5 or higher on criteria described in application rubric.

Aligned with DQP Learning Areas:

1. Specialized Knowledge

2. Broad Integrative Knowledge

3. Intellectual Skill/Core Competencies

4. Applied and Collaborative Learning

5. Civic and Global Learning

Longitudinal Data:

	2011-12	2012-13	2013-14	2014-15
N of Students	22	15	17	11
Class	E&M	Nuclear	E&M	Nuclear
% above 2.5	71 %	84 %	88%	82%
met criteria	no	yes	yes	yes

Note that some raw student work was missing and a mapping method was used to approximate application of the rubric to appropriate questions on the final exam. This method probably gives a reasonable estimate of data though direct use of the rubric is preferable.

Additional Data: In a 2015 survey of graduating seniors, students typically (7/8) rated themselves as either high satisfactory or outstanding in this category. One student, who rated themselves as low satisfactory, suggested adding a seminar in applications.

Conclusions Drawn from Data: Typically our students are doing well. Though not directly measured, we have noticed occasionally students struggle knowing when computational tools are most appropriate if not prompted in some way.

In establishing this learning outcome, review of the curriculum tended to show that we had previously not focused as much on applications within courses. The computational piece has been strengthened by utilizing tools such as MATLAB through several courses from freshman through senior level.

Changes to be Made Based on Data: Increased use of computational techniques including introductory physics lab, modern physics, and various upper division classes.

The degree to which students evaluate their solution is also varied. Typically this has not explicitly been a required part of problems being solved. It is recommended that at least periodically an evaluation of their solutions be an explicit part of problems rather than the hope that students have learned the good habit of evaluating their solution when they have finished it, and assume that this is taking place.

Rubric Used: Physics and Engineering Application Rubric

Physics and Engineering Application Rubric

	Outstanding	High satisfactory	Low Satisfactory	Unsatisfactory
Demonstrates knowledge of relevant physical principles	☐ Identifies all the appropriate physical principles necessary to solve the problem, and can provide clear reasoning why these principles are applicable and useful	☐ Identifies all physical principles necessary to solve the problem, but cannot clearly articulate why each principle is applicable and helpful in arriving at a solution	☐ Identifies most of the relevant physics	☐ Cannot identify relevant physics
Correctly applies physical principles	☐ Efficiently uses identified physical principles to move toward solution	☐ Uses identified physical principles to move toward solution	☐ Application of physical principles contains few errors	☐ Application of physical principles contains many errors
Applies mathematical techniques, concepts and processes	☐ Mathematics are used correctly and efficiently to move toward a solution	☐ Mathematical techniques are used correctly with few or no errors	☐ Mathematical techniques are used correctly with several errors	☐ Mathematical techniques contain many errors
Demonstrates knowledge of computational techniques	☐ Can articulate why a particular computational technique or tool is useful	☐ Can identify relevant tools and techniques	☐ Identifies some tools or techniques which may work	☐ Cannot identify computational techniques applicable to the problem
Application of computational techniques	☐ Uses appropriate tools to formulate a complete solution efficiently and correctly	☐ Arrives at a solution which is correct	☐ Arrives at a solution which may contain some minor errors	☐ Does not arrive at a solution
Evaluation of solution	☐ Can evaluate solution for correctness either using alternate methods or reasonableness using physical principles	☐ Can evaluate the solution generally based on physical principles	☐ Rough evaluation of solution without clear reasoning	☐ Cannot provide any evaluation of correctness of solution